No. 52 Aug-Sept 1993

# solplan review

the independent journal of energy conservation, building science & construction practice

## Inside . . .

Ventilation of roof spaces is called for by code. But do we know if it really works and how much is needed? It turns out that it's one of those rules that's been in the code, but there is little information to justify it. We present the findings of a study that measured attic air flows. New low density fibreglass products are now being imported, but it seems that unless it is installed perfectly, it doesn't perform as well as more dense products according to an IRC study.

Other items include a report on the performance of sump pumps; information about a new lumber kiln; an update on the Advanced Houses, a review of David Rousseau's new sourcebook for environmentally suitable materials, TRC News, and much more.

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# Attic Ventilation

## From the Editor . . .

It's amazing what happens when emotions get in the way of facts. No, I'm not talking about the latest pronouncements of aspiring politicians seeking election. I am referring to people you would normally expect to exhibit some moderation and care in their pronouncements, who in fact put the backroom political manipulators to shame.

I am referring to the fire fighting establishment. Now before someone misunderstands me, I respect them very much for their work. We couldn't do without them and their valiant efforts. They not only fight fires, but are also the first response team in all kinds of emergencies - not just fires.

What has got me thinking about the deviousness and biases of the fire fighters is their behaviour in the sprinkler issue. I've read a batch of recent correspondence on the issue. The fire fighters are, rightly, pushing for action that will enhance life safety and reduce pain and suffering. They insist that only by putting sprinklers into all houses will that be accomplished. While the arguments being presented by the fire fighters to various municipal councils across the country claim to be impartial, they in fact contain many half truths and emotional pleas. (In another context it could be called simple propaganda).

It's difficult for anyone, especially a politician, to contradict such emotional presentations. For the politicians it's as if they were being asked "when did you stop beating your partner?" - a question that doesn't deserve an answer.

What I haven't seen any fire fighter do is to promote the use of sprinklers on a voluntary basis - and get public adoption of them that way, not unlike the way whirlpool tubs, wall to wall carpeting and other new items have been introduced into the marketplace - to the point that in some markets it would become unthinkable not to install them.

One big argument used by fire fighters is the cost savings - but they don't acknowledge the initial capital expense. There is a high cost not only to the individual home owner, but also to the municipal infra structure. More importantly, what is not acknowledged is the fact that fire fighters will respond to any call - not just unsprinklered buildings, so there is not much chance that a jurisdiction will reduce the size of the fire department!

It turns out that there have been a number of studies done, many funded by CMHC, to determine what the impact is of putting sprinklers into all dwellings. All suggest that it is a very expensive proposition, and not very cost effective.

The zeal with which some chiefs are pushing them, one would think that they have a share in the sprinkler installation industry!

Richard Kadulski,
Editor

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# Attic Ventilation

Attic ventilation has been the accepted method for controlling moisture and overheating in attics. But does it really work? Does it really do what it's supposed to do?

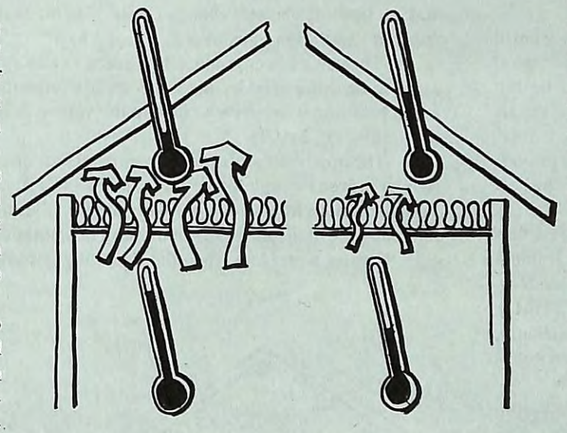
In theory, the small amount of water vapour that finds its way into the attic will be moved directly to the outside, primarily by air movement through the vents. However, it is likely that sometimes the rate of moisture movement into the attic will be more than the rate being removed, so condensation will occur. At other times, because of heat gain, the moisture will evaporate.

The Building Code requires that the total vent area must be 1/300th of the attic floor area. If this is enough, too much, or not enough has never really been tested. It was determined by accident, as there are few studies that set out to measure typical attic ventilation rates and what effects they have on moisture in the attic at various times of the year.

Some studies have tried to model the moisture in ventilated attics, but all of these focused on developing a detailed theoretical picture of the interaction between the wood components (roof sheathing and trusses) and attic air. In all models the single largest mechanism moving moisture was that associated with the flow of air from outdoors (ventilation flow) and air leaking into the attic from indoors. Unfortunately, the quantity of air flow and indoor air to attic exchange are not known, nor is it known how these flows change with changing weather conditions.

To answer these questions, a study (part of a Ph.D. thesis) was undertaken at the University of Alberta Home Heating Research Facility.

Detailed measurements were carried out over a two year period in two separate attics. Measurements were taken of the ventilation rates, indoor-attic exchange rates, temperatures, and moisture content. A model was developed to predict the moisture performance of an attic for a given leakage configuration and weather conditions.



Generally attics with no significant air leakage from the house required little ventilation and, in fact, would have higher wood moisture levels if over-ventilated. However, if there is significant air leakage from the house into the attic, sealed attics were most at risk.

One attic was configured as a "tight" attic with no intentional vent openings, while the other attic had soffits along the north and south sides and two roof vents with a total vent area that met the code requirement of 1:300. The background leakage of each attic was measured by blocking the roof vents and conducting fan pressurization tests on the attic.

It was observed that indoor-attic exchange rates (the leakage of air from the house) is mainly dependent on the temperature difference between the house and attic. This means that the main reason for this air flow is the "stack" effect, as there was little or no correlation of this flow with wind speed.

A theoretical model was developed using the data gathered, and was tested against actual measurements. The results provide some interesting data. The standard attic with soffit and roof vents has a high ventilation rate which keeps the attic air temperature relatively cool, but despite the cool temperatures, these conditions do not lead to excessive sheathing wood moisture contents or any condensation on the sheathing.

Sealing the attic (as is common in many parts of Canada) reduces ventilation rates dramatically resulting in relatively high attic air temperatures. Unfortunately, all of this ventilation flow comes from the interior of the house which moves more moisture into the attic. The result is a net daily accumulation of moisture on the sheathing which ultimately would lead to problems. Adding an exhaust fan in the sealed attic provided no benefit despite the increased ventilation because the fan just pulled in more warm moist air from the house.

In another test the sealed attic was ventilated with a balanced fan system that operated continuously. This was an

improvement over the sealed attic or exhaust only, but not enough to prevent moisture form accumulating on the sheathing. However, the performance was no better than the standard attic and in fact, was a bit worse with slightly higher sheathing moisture contents.

Simulations showed that in a maritime climate moisture problems were always worse than in the dryer and colder prairie climate. This is because moist maritime air has less ability to remove moisture from the attic than does dry prairie air.

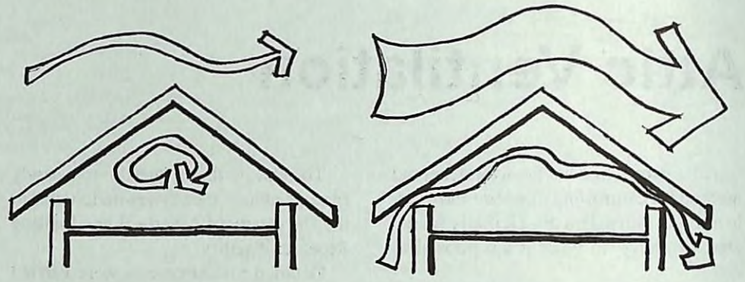
Attempts to optimize the attic venting through the use of fans, rather than passive vents, were only moderately successful. For mechanical ventilation of attics, fan ventilation worked best when the fan was only on during the day when attic temperatures are relatively high and the potential for removing moisture is high.

A single fan installed as a supply fan to pressurize the attic could provide good moisture control, but it had to be big enough to reverse the direction of the air flow though the ceiling and not over-ventilate the attic. A supply fan providing 5 ACH was found to produce the best results.

The simulations using balanced fans in sealed attics showed that the ambient conditions are an important consideration in fan installation. The use of fans to control moisture in an attic space should, obviously, be only considered as a remedial requirement for special cases.

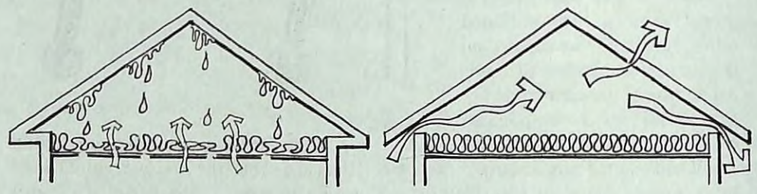
The net result? Does attic ventilation work? Yes, but the most important consideration still is to seal the room ceiling with good air and vapour barrier to reduce the potential for air and vapour movement into the attic space.

*Attic Ventilation and Moisture by T.W. Forest and I.S. Walker, University of Alberta, Edmonton, Alberta; a study carried out as part of a Ph.D thesis for Mr. I.S. Walker with the support of CMHC*



Other observations made during the testing of the attics were:

- Attic ventilation rates are dominated by wind action. There was a direct relationship between increased ventilation rates and increased wind speeds.
- The total attic vent area required by the Building Code produces attic ventilation rates (in an unsheltered location) of about 3 ACH (air changes per hour) for each meter/second of wind speed (2.2 mph) which is about 13 ACH in the attic with a 10 mph wind.
- Attic ventilation rates are sensitive to wind direction, particularly when there was an upwind obstacle that provided shelter; shelter from neighbouring houses reduced ventilation rates by a factor of 3 to 4.
- The stack effect produced by house to attic temperature differences does not seem to be influenced by the wind speed. Stack-driven attic ventilation rates are much less than wind-driven rates; in the vented attic, peak stack-driven rates were approximately 2 ACH.
- The important moisture sources in an attic are indoor moisture from the house (which moves through the ceiling) and exterior moisture brought in by ventilation flows. Moisture from inside is dominant when the attic is well sealed and ventilation rates are low. Moisture due to ventilation flow is dominant when ventilation rates are high. It poses a problem when the sheathing is cooled at night.



- High ventilation rates don't reduce attic air relative humidity, wood moisture content or condensation, and the worst case results always occurred at high wind speeds. In this case, the moisture source is the humidity of the outdoor air.
- Sealed attics had low ventilation rates and consequently, were warmer than ventilated attics but this was offset by indoor-attic air flow that moved large amounts of moisture from the interior into the attic. This results in high wood moisture contents and condensation problems in all climatic zones.



# Fibre Insulation

## *Does it Perform as Advertised? Is density an issue?*

*by John W. Archer*

Everyone is price sensitive so when buying any product the tendency is to buy the lowest cost product. Not to do so would be fool hardy. But are all products equivalent?

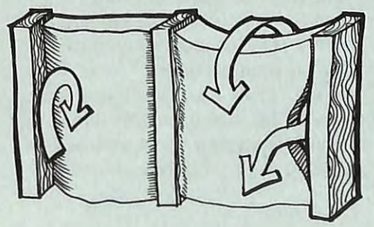
New lower-cost, lower-density mineral fibre insulation (MFI) batts are now on the market. Although equivalent R values for the batts may be stated on the packaging, it would be wise to question whether they really perform in an equivalent manner. The question is whether new, lower-density batts perform like other types of insulation, or are they more susceptible to convective heat losses?

Convective heat loss happens when air moves around and through the insulation from the warm to the cold side and back again. This "loop" of air carries heat with it and can dramatically affect the thermal performance of an insulated wall. It is like leaving a window open on the ground and second floors of your house in winter - it doesn't matter if you have an R60 wall.

Glass and rock wool insulation have been used for decades. During the 1950's and 1960's paper-backed batts for walls were in common usage. "Friction fit" MFI products became available in Canada in the 1970's and quickly replaced the paper-backed batts. These products were made in sizes and thicknesses to fill the whole wall cavity, slightly oversized so as to be held in place by friction.

Recent changes in manufacturing have significantly reduced the size of the fibres so that batts with densities of almost half those of the early 1970's are now being manufactured. These new products retain almost the same thermal performance when measured by standard laboratory tests. However, do these lower-density batts perform as well in the field?

*on a cold winter day... a small gap or imperfection reduces the thermal resistance by 20% to 36%*

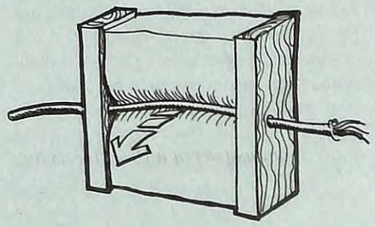


The concern is that they would be prone to convective loops, and thus heat loss. This was supported by anecdotal evidence for the poor field performance of low-density MFI batts coming from a variety of sources.

In the early 1980's a series of tests found that the performance of low density loose fill attic insulation products was seriously degraded because of convection loops that could be established in the insulation. As a result Canadian manufacturers modified their product so it was less prone to convective effects. Basically, the structure of the batt was changed to decrease air permeability. Also, the Canadian standard for loose-fill MFI was amended to require a minimum level of thermal resistivity. The effect of these two actions was to set a minimum density for MFI products in Canada. American manufacturers and standards did not follow suit and continue to produce lower density MFI batts.

A recent US study reported that full scale measurements of a similar glass fibre product was 30% less than predicted. Unlike Europe, in North America thermal resistance is measured in a laboratory (under ideal conditions). This is considered good enough for estimating actual performance. It is not general practice to determine thermal resistance in the field or under field conditions, although these can drastically alter the performance.

The building industry in Canada has access to both the Canadian and American products, as well as higher density batts made from rock wool. The density difference between the three is quite noticeable. But is the difference important? Do they deliver their rated thermal performance when installed in a wall subjected to a more "real life" environment? Are the low-density products at risk from convective heat loss? Can convective loops occur inside mineral fibre insulation when there is a big temperature difference between inside and outside and the density of the glass fibre is low enough? What effect can small gaps in the insulation have?



To try and provide the answer to these questions, the National Research Council's Institute for Research in Construction (IRC) recently did some studies. Both batt density and batt installation effects were studied. The results are very interesting - and significant!

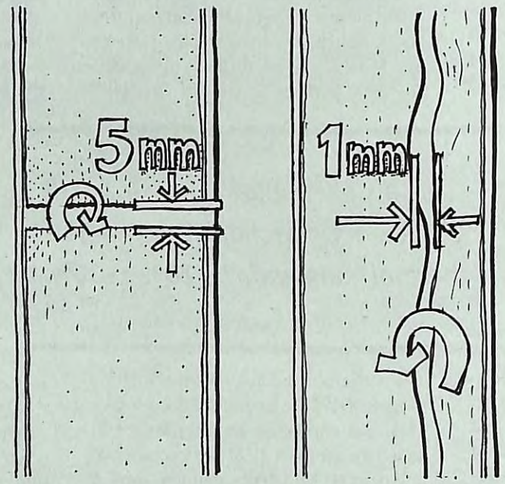
The MFI-insulated cavity walls were built to good practice: in other words - "perfectly". A series of stud cavities were built, each with different densities of MFI, including a sample of low-density American product. The walls were exposed to temperatures typical of the difference between the inside and outside of a building on mild and of more severe winter days. The thermal performance of the walls was measured for both situations.

The results showed that all performed thermally as their ratings and standard calculation theory predict. No convective heat loss loops were detected, even in the lowest-density MFI at the lowest temperature (-35°C).

But density is only one issue affecting thermal performance. The quality of installation is also important. This became evident to the researchers because of the difficulty they had in installing the low-density batts. These batts did not have good "rebound" characteristics and it was difficult to make sure that the batt was completely in contact with the sheathing before the cavity was closed.

The impact of major installation defects such as an air gap on both sides of batt insulation is well known - thermal performance is reduced. However, if you can ensure that one side of the batt is flush with an air barrier, thermal performance is dramatically improved. This is why the National Building Code requires that batt insulation products be installed so that at least one face is in full and continuous contact with cladding, sheathing or other air-impermeable membrane.

Canadian manufacturers have developed their product to achieve this full contact by giving a strong "rebound" characteristic to the batts. But there are other challenges to using this material on site. Installers must deal with non-standard cavity sizes, warped studs, blocking, pipes and electrical boxes. Each cut to accommodate these irregularities provides an opportunity for a gap between the batt and the air barrier to occur.




Studies of gap size and location show that a horizontal gap as small as 4-5 mm (less than the thickness of a pencil) can be enough to start convective air flow from one side of the cavity to the other. But it only takes a 1 mm gap if it runs vertically. This is the kind of gap that happens when the batt has been "tucked in" along the edge of the wall stud and has not fully rebounded.

The IRC researchers rebuilt the test cavities with a defect. A small triangular-shaped gap was created to run up and down along the stud on both sides of the cavity. One series of tests had a gap that was about 3% of the total volume of the cavity. The second series tested had a gap of about 6%. Each series was repeated with the three different density MFI products.

The thermal resistance of the cavity was reduced in all cases studied. Gaps of 3% , with a temperature difference typical of a mild winter day (+20/-5°C), showed a total thermal resistance drop ranging from 2% to 5%. But when the gap was 6% of the cavity and the temperature difference high, typical of a cold winter day (+20/-35°C), the loss of thermal resistance ranged from 20% to 36%. The lower-density batts performed the worst.

Thus in the cold Canadian climate installation defects, particularly when combined with lower-density batts, can be a significant contributor to poor wall thermal performance. Builders need to be aware of the importance of good workmanship in batt installation and factors that may affect the rebound characteristic of the batt.

Some things to look for are:

- Has the batt been stored in a compressed condition for a long period of time? This can affect rebound characteristics.
- Is the batt wet, or has it been exposed to high humidity levels (such as can happen if the bag has been punctured)? This can also affect rebound characteristics.
- Do the wood studs used in the cavity walls conform to the National Building Code requirements for moisture content (19% at time of installation)? They can warp and cup, affecting the fit of the batts.
- Does the insulation product meet Canadian standards? Products manufactured for the American climate and needs may not serve well.

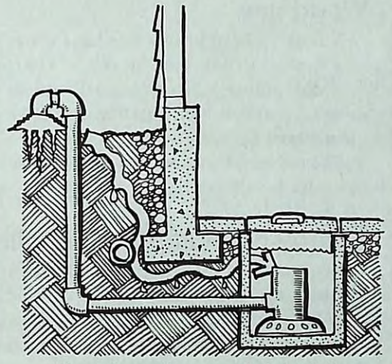
*Continued on page 7*



# Sump Pump Performance

Many municipal sanitary sewer systems are not designed to handle significant foundation drainage and basement flooding due to sewer backup has resulted. The City of Edmonton has bylaws prohibiting the discharge of foundation drains into the sanitary sewer system.These apply to new as well as extensively renovated residences.

Because there have been many problems with sump pump systems such as ice build up, wet yards, pump failure, lack of homeowner confidence and general dissatisfaction with systems, the Innovative Housing Grants Program of Alberta Municipal Affairs supported a study of pump systems. The objectives of the study were to identify the common problems associated with existing sump pump systems; to determine which of the problems can be resolved in the design stages; and to field-test proposed system modifications.



The information revealed the following:

- For single-family residences in neighbourhoods where sump pump systems are mandatory, only a small number are active
- Of those that are active, most are perceived by the residents to cause problems.

The most common problems identified are:

- The discharge of water onto sidewalks, roadways, and lawns causing icing in winter and saturated lawns in summer.
- Homeowners fear that potential power and/or pump failure will result in basement flooding.
- The lack of standards, guidelines, and requirements for sump pump systems which places the responsibility for system design on the builder or homeowner.
- Homeowner's liabilities and responsibilities for a sump pump system serving a multiple unit housing development are not clearly defined.

Filed tests of four systems found the following:

- All four pumps tested worked satisfactorily.
- Larger sump capacities provided protection in cases of power failure and/or pump failure. The sump caused pump failure on two occasions when sloughed wall material plugged the pump intakes.
- A standard car battery used as a source of stand-by power was not successful due to its limited power capacity. In addition, the potential hazards of storing a wet cell battery inside a dwelling unit would have to be considered.
- When sump water was discharged off-site or away from a backfill zone with a positive slope, very little was recycled into the weeping tile system.
- The performance of sump pump systems sites could be improve through better construction and design practices.

Recommendations made by the study include:

The sump should be completely lined. Concrete, treated wood, or plastic could be used, and the bottom should have drainage holes.

For active systems, the sump should have enough storage volume to hold foundation drain water for about 2 hours, based on a design rate of water flow established by the municipality for the area and/or neighbourhood. The minimum sump volume should be 0.5m3 for less active sump pump systems. This size, much larger than the minimum recommended by code, allows easier accommodation of floats and cables and makes maintenance easier.

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*Attic Ventilation (con't from p. 6)*

Has care gone into fitting the batts to irregular conditions? Gaps can significantly reduce thermal performance.

The National Building Code requires that batt insulation have at least one side in full contact with an air barrier.

*John W Archer is a Senior Advisor in the Industry Liaison Branch of the National Research Council's Institute for Research in Construction.*

Sump pumps should be durable and capable of pumping a minimum of 1.5 L/s at 2.5 m of total dynamic head.

The discharge from sump pump systems and roof leaders should be defined as storm water and be considered appropriately within the lot drainage plan and the subdivision drainage plan.

The locations of sump, sump pump discharges, and roof leaders should be identified on the house plans.

On site management of sump water and roof discharge within designated areas, such as on site infiltration/detention basins, represents a workable alternative to direct surface conveyance to a minor or major storm system.

Standards and regulations of sump pump systems should be addressed by regulatory authorities so that system requirements would fall within one act and jurisdictional area.

*Sump Pump Study by CH2M Hill Engineering Ltd. for Alberta Municipal Affairs Innovative Housing Grants Program*

# Did You Know?

## Interesting facts from here and there

### Wood use

To cut 2 - 2x10 joists a tree has to have at least an 11" diameter trunk?

The same tree that produces 2 - 2x10 can produce 10 - 2x4?

A conventional 28'x40' bungalow floor requires 42 trees to produce enough 2x10 joists? A parallel chord joist that uses 2x4 top and bottom chords and metal webs needs the material in only 13 trees?

The engineered wood joist not only uses less lumber, but it can also used recycled metal for the webs.

### Energy consumption of toilets

Bet you never thought that toilets consumed energy.

About 40% of all water used by the typical house is used by conventional toilets. In a cold climate, such as on the prairies, these toilets can use up around 1400 kWhr of energy over the year. It's not that the toilets use energy, but the cold water coming into the toilet tank scavenges heat out of the house. The water in the tank, being very cold, slowly gets warmed up before its needed to flush. This is also why the toilet is always so cold!

This is another reason for using water conserving toilets and insulating tank liners.

### Gas appliances

A standing pilot light uses the equivalent of 2500 kWhr per year of energy.

### Gas range venting

Gas fireplaces typically have an output of 15,000 to 35,000 BTU/hr. Regulations call for all fireplaces to be vented directly to the outside. The standard gas range burner has an output of 9,000 BTU/hr (4 burners thus have a total output of 36,000 BTU/hr) - but there is no requirement that the gas stove be vented to the outside!

While most gas ranges are installed with fans that exhaus to the exterior, isn't it time that this be made mandatory?

## Ventilation handbook

Fresh air in buildings is a necessity for health. Just how important that is has been learned recently. That also means that a ventilation system must work properly to do its job.

The air change rate required will depend on how the building is used and how many people are in the building. Various household activities such as cooking, baths, laundry, cleaning, and hobbies will all add to ventilation needs.

A handbook that covers both new and existing buildings has been prepared that describes how common ventilation systems work, what common problems may be, and how they can be resolved. It is intended for building owners, managers, designers, building and public health authorities.

Just what you need? You must have a copy? How's your Swedish? It's only available in Swedish as it was prepared at the initiative of the Nordic Ventilation Group. Perhaps it's time for some group to do one for the Canadian context.




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- ✓ manufacture of prefabricated stress skin panels
- ✓ assembly of engineered wood products
- ✓ exterior finishes, including innovative roof tile materials
- ✓ high performance windows
- ✓ services that are behind the surface (electrical, home automation wiring, plumbing and heating, septic, etc).

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## The Printer goofed!

In the last issue we printed the winner of the SESCI Autonomous House Award, which recognizes environmentally sensible, very low energy Canadian homes. Our printer's quality control failed so the photograph of the winning house was not legible. We reprint the photo of the Parker residence in Victoria, B.C., the 1993 winner of the award.



**BACK ISSUES SPECIAL**
We still have some back issues of SOLPLAN REVIEW. Individual copies of back issues are available for $4.50 each, post paid.

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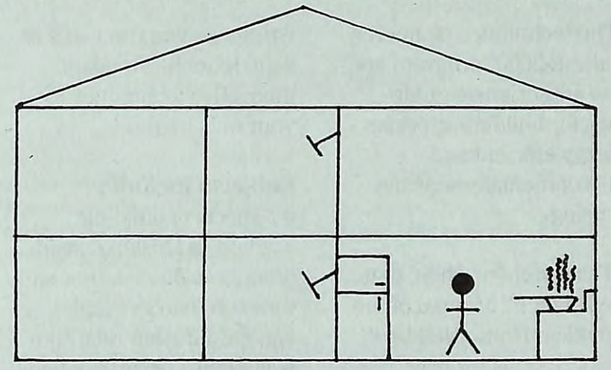

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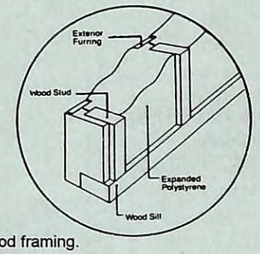


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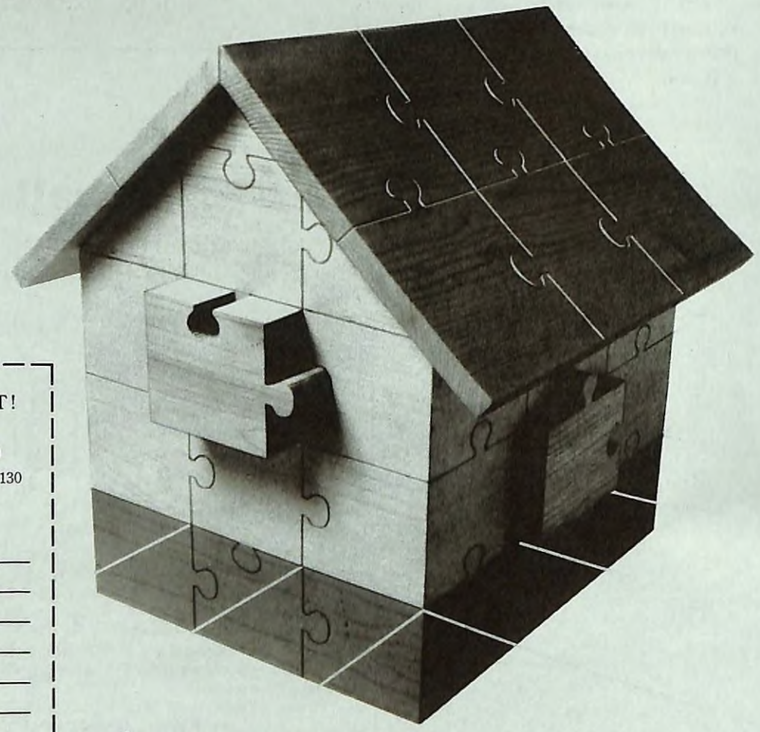

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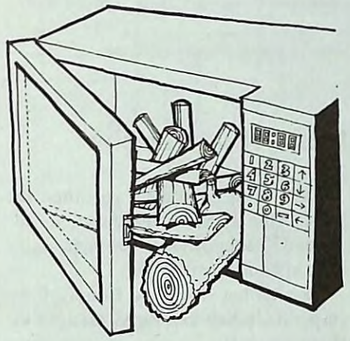
## Microwave Lumber Kiln



Microwave lumber? It sounds like one of those strange urban legends!

Conventional kiln-drying technologies work like a kitchen oven to evaporate the wood's naturally-stored water. They work well for drying standard sizes of lumber, but they are not as efficient for drying thicker cuts of lumber. This process may result in uneven drying. To encourage even drying the lumber is "stickered", that is small pieces of wood are placed between layers. But stickers can stain the lumber and reduce kiln capacity. In addition, conventional kiln drying can take up to four months for six-inch timbers.

However, there is an increasing demand for kiln-dried wood, and large timbers are a significant proportion of B.C. wood exports, so British Columbia's Council of Forest Industries (COFI) looked at alternatives to conventional kiln-dry methods.

What was developed was a radio frequency/vacuum (RF/V) kiln which operates like a microwave oven: electromagnetic energy penetrates the wood to its core, converting internal water molecules to steam. The steam exits the wood at its ends. The result is a uniformly dried wood with minimal defects. In addition, RF/V kiln drying requires substantially less time than conventional kilns. This increases both yields and mill productivity.

Tests at a prototype mill have been going on since March 1993. COFI estimates that the new kiln is as much as 70% efficient, (twice the efficiency of conventional kilns). As a bonus, the dried lumber is superior in quality to that dried in conventional kilns since the kiln is expected to be capable of raising the temperature of the wood to a high enough level for a sufficient period of time to destroy the pinewood nematode.

A final benefit is that the RF/V kiln promises to be an environmentally friendly alternative to conventional lumber kilns as it reduces environmental impact on air quality. If 62 kilns are installed across Canada this could displace up to 50,000 tonnes of $CO_2$ per annum.

## Community Service Award

Your humble editor is one of those people who has a hard time saying NO. He is active professionally, serving on a number of committees at the Architectural Institute of B.C., as well as CHBA - both at the provincial level in B.C. and with the Greater Vancouver Home Builders, and as Director of the Solar Energy Society of Canada. He's also had a hard time saying no to the City of North Vancouver, where he has been Chairman of the community's Advisory Design Panel, as well as serving on the Board of Directors of the North Shore Neighbourhood House (a community based social services agency), where he has just stepped down from the presidency.

I guess because of those various activities, the Greater Vancouver Home Builders's Association presented **Richard Kadulski**, your humble editor, with the 1992-93 Community Service Award for "*outstanding community service*".

I can't say anything other than thank you! RK

## Legionella in water systems

Legionella bacteria is a potential health hazard because if the bacteria is inhaled in sufficient concentrations, it can be deadly. The bacteria lives in water at relatively low temperatures. Fortunately, deadly outbreaks of legionella are not common, but as a recent incident in B.C. showed, it can happen anytime. In the B.C. case a couple died due to an outbreak of legionella in a hot tub they had recently acquired but evidently had not maintained properly.

A recent Swedish study to determine how common legionella bacteria is in Swedish water systems found it was present in 15% of water samples. The incidence was low in cold water samples but became noticeable in warm water. It was noted that the frequency of samples with legionella bacteria increased with the complexity of plumbing system. Single family and small multiple dwellings had the lowest positive readings.

Legionella was found in all water heaters with an outlet temperature of less that 50°C (122°F), and in large water heaters with no water circulation. Systems that had a mixing tank after the water heater are a risk unless the temperature is not lower than 60°C (140°F) and circulation can be guaranteed.

Some materials used in shower hoses and gaskets may provide good environments for growth of legionella.

# EMR/CANMET NEWS

*The Canada Centre for Mineral and Energy Technology (CANMET) is the research and development arm of Energy, Mines and Resources. EMR/CANMET's Buildings Group works with industry to develop and commercialize the technologies to make Canadian houses more energy efficient. With the support of the Buildings Group, Solplan Review presents this information on some current CANMET projects. For more information contact: Energy Efficiency Division, EMR/CANMET, 580 Booth St., Ottawa, K1A 0E4.*

## Advanced Houses Attract Attention

The Advanced Houses program has resulted in 10 state-of-the-art homes showcasing a wide range of new products and technologies. Of special interest are the many new approaches to energy efficiency and environmentally responsible construction. They demonstrate that Canadian building technology is second to none in the world.

The program started in late 1991, and during 1992 much of the planning work was done. Two of the homes (the Saskatchewan Advanced House in Saskatoon and the Manitoba Advanced House in Winnipeg) actually opened in late 1992 and have now been sold. The other houses were later in getting built and are still in the demonstration phase, so you still have the opportunity of visiting them.

Why should you visit them? The public is!

Complete data from all projects is not available. The NEAT Home in Hamilton and Maison Novtec were officially opened on September 9, 1993. Over 10,000 people have visited the Waterloo Green Home since it opened late April; over 10,000 visitors toured the B.C. Advanced House during the first two months; over 9,000 have visited the Envirohome in Halifax; 40,000 have visited the Saskatchewan Advanced House (which has now been sold); the Manitoba Advanced House had to get help with crowd control at one point during their open house!

So one of the objectives of the program - to increase public awareness in new building technologies is happening. Some suppliers of new products are reporting a lot of interest in their materials.

If you haven't visited any of the houses, do before it's too late, and don't leave it to the last day! If you live too far away to get to a house, but want to get more information, you may still be able to get some details about the projects, as each has prepared an information package about the features of their house. Some have put together a video, and copies should be available for a modest fee.

Houses that are still available for viewing (and phone numbers for information on open house hours, address, etc.):

**B.C. Advanced House**
(604) 689-1842

**Waterloo Region Green Home**
(519) 576-0306
**NEAT Home** (Hamilton)
(416) 575-3344
**Innova House** (Ottawa)
(613) 723-5907
**Maison Novtec** (Montreal)
(514) 848-8770
**Maison Performante** (Montreal)
(514) 353-1120
**Envirohome** (Halifax)
(902) 835-4422
**PEI Advanced House** (Charlottetown)
(902) 368-3303

For information on the Advanced Houses Program itself, contact Tim Mayo, Program Manager, at CANMET, (613) 996-3089; Fax (613) 996-9416

## NEAT Home opens

The Advanced House in Hamilton, the NEAT (the Novel Environmental Advanced Technology) was officially opened September 9, 1993.

As all other Advanced Houses, it incorporates many innovative features including:

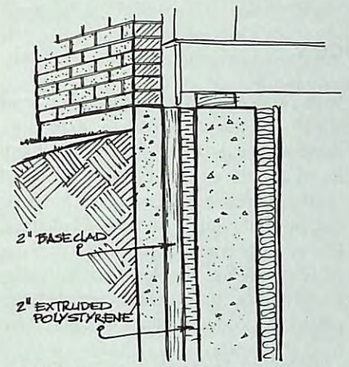
- CEBus control system permitting the integrated control of all electric and electronic devices in the home
- state-of-the-art integrated space heating and cooling, domestic hot water, ventilation and heat recovery system
- aggressive water conserving plumbing design
- rain water cistern for operating an evaporative cooling system
- use of innovative, small dimension lumber for framing of floors and walls
- high technology glazing system
- extensive use of recycled building products
- integrated "in-law" suite

The NEAT home is located at the corner of Rymal Rd and West Lawn in Hamilton. For details of opening houses, call the Hamilton-Halton Home Builders' Association (416) 575-3344

If you go and visit the NEAT home, plan your route to take in a visit to the Waterloo Green Home in Waterloo - it's a short 45 minute drive from the NEAT home. For information on the opening hours of the Waterloo Green Home and how to find it, call (519) 576-0306.



## Basement Insulation Alternative




With the increased demands by energy codes to provide full depth basement insulation, the question becomes how to do it economically.

Full height insulation on the interior means that there is an extra cost for finishing and pre wiring that must be done at time of construction. Interior finishing can be avoided if the insulation is placed on the outside, but then again it requires special attention and protection of the insulation at grade. Where brick is used as exterior finish, there is a further problem of how to support the brick veneer.

An interesting feature of the NEAT home is its foundation wall construction.

The designers developed an innovative foundation sandwich wall. In most situations, the interior foundation wall could then be left unfinished. In the case of the NEAT home there was additional insulation placed on the interior because of the requirement in the Advanced Houses program for extremely low energy consumption.

The foundation wall has a 6" structural foundation wall and a 3" concrete exterior wall (to carry the masonry veneer) that are poured in place at the same time. The double layer of insulation is placed between the two concrete withes 2" of polystyrene (R10) and 2" rigid fibreglass (Baseclad - R8). The baseclad is placed on the outside, and is there to provide a drain layer as well as insulation. Using a double withe wall, the insulation is fully protected.

The rigid fibreglass board provides water proofing because of the properties of the material. Any water coming in contact with it will flow down the fibres along the surface as this is the path of least resistance for the water. In this manner the insulation also provides water proofing for the basement wall (as long as proper drainage is provided at the base of the wall). The insulation boards are kept in place prior to placing the concrete, with plastic ties. Because the exterior concrete goes to the top, it directly supports the brick veneer.

## Residential Ventilation Systems

The environment in houses has a major impact on the health, comfort and well-being of the residents. Up to now, improving the comfort of the home has focused on adding insulation to the building shell to reduce heat losses.

While much is now understood about the thermal performance of buildings, the role of ventilation often remains a secondary consideration. The main reason for ventilation in homes is to meet the metabolic needs of occupants. Ventilation air also dilutes and removes unavoidable pollution generated within the building, although it should not be relied on to compensate for building pollutants.

In the past, ventilation was provided by natural means. Usually, this simply meant the natural air leakage of the building.

Homes present special problems as there are so many activities, appliances, heaters, furnishings, etc that take place there which contribute water vapour and other pollutants into the indoor air. However, it is clear that more effort is needed to understand the role of ventilation and how to implement good design to existing buildings as well as to new buildings.

Various approaches have been taken in different countries to deal with increased pollutant loads and to improve indoor air quality. In Canada we've seen different approaches to ventilation of homes. The International Energy Agency has established a new project - Annex 27 - to deal with some of these issues. This project has been given a 5 year time frame to produce its work.

Annex 27 tasks are to review and classify residential ventilation systems used now and to develop techniques which may by used to evaluate the performance of domestic ventilation systems for various climate conditions, construction types and occupancy patterns. They hope to develop simple tools to enable proper decisions to be made at the design stage.

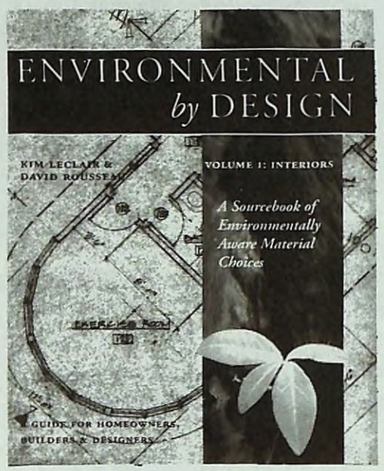
Nine countries representing a range of ventilation, building construction and climate types are active in this group. The focus for the group is on the implications for space heating.

The first step will be a comprehensive review of current methods used to ventilate the home. This will include a review of what is being used in different countries by building types and technologies, and will also review how much market penetration various systems have. The energy and indoor air quality impact, system cost and payback periods will also be evaluated.

The second step will be to look at ways to improve existing methods of evaluation of ventilation system performance. This is important as the ultimate goal is to provide the designer with tools to assess both energy use and indoor air quality in relation to type of building construction, occupancy loading and climatic conditions at the design stages (when its much cheaper to make changes).

# Environmental by Design

## *A Source book of Environmentally Aware Material Choices*




In this health conscious, environmentally aware era we can no longer ignore the fact that many of the common materials used indoors present serious problems for both our personal health and that of the planet.

We know, for example, that carpeting alone can be a source of indoor air pollution that can contribute to a number of distressing health symptoms. In addition, discarded carpeting makes up to 3% of landfill waste which may not degrade for hundreds of years. Other less obvious impacts: are that most synthetic carpet fibre comes from non renewable petroleum sources and is often installed with synthetic glues. All these materials emit harmful gases and are neither renewable not biodegradable. Plus there is the dying (which yields huge quantities of polluted waste water), the uses of hazardous chemicals for stain-resistance, and other unsafe chemicals for cleaning. There are grave health effects on many of the workers who produce all these materials.

Much of this is also true for insulation, interior panelling, vinyl flooring, installation materials (e.g., adhesives), wall coverings, paints, finishes, furniture, and maintenance products (polishers, etc.).

Materials that have some special environmental and health merit generally use less energy in their production, involve less natural resource depletion and pollution, and are generally less toxic than many conventional materials. But how to find out what's a suitable material? Manufacturers have been making environmentally sound changes in their procedures and products, but how many of the claims are true? How can the builder or designer make sense of claims that may be conflicting? If the manufacturer picks up the scraps off the plant floor and puts them back into the hopper - can he claim the product is recycled (or contains recycled content)?

Some put a lot of emphasis on natural materials. But are natural materials the answer? Many materials, such as wood and plant oils are potentially renewable. Others, such as sand, though not renewable, occur in vast quantities in nature. Generally, the less manufactured a material, the less air and water pollution and energy use are associated with it. Many natural materials also have lower toxicity than their synthetic counterparts. Some have been proven safe over centuries, while new synthetics may or may not prove safe over time. We have to start thinking about the actual cost of materials, which include the health and environmental costs, not just the initial purchase cost.

There now is a source book, **Environmental by Design**, that contains a lot of practical information, providing not just the generic information but also names and addresses for specific products. **Environmental by Design** describes a wide range of materials that are healthy to live with, relatively benign for the planet and which are not produced by exploiting those who make them. Among the many listed are, for example, wall panels and insulation made from recycled newspaper, floor tiles made from recycled glass, low toxicity water-based adhesives, durable natural finishes, low toxicity water-based paints, carpets waste recycled into plastic byproducts, and reusable shipping containers.

Various organizations are working on labelling and assessment systems for products. It is not a simple thing to do. The authors did their product evaluations largely on the basis of questionnaires supplied by manufacturers, checked against known industry standards and practices. To help review the properties of products at a glance, a set of graphic symbols was developed.

Issues that are covered in the book include:

**Production issues**: including recycled content, sustainably acquired or renewable raw materials, in-plant energy efficiency and recycling, and low emissions at the plant.

**Packing and shipping issues**: whether packaging is minimal, durable, reusable, returnable or fully recyclable; and products with reduced transportation impacts, either by alternative shipping formant or by policy of regional production.

**Installation and use issues**: including products that can be installed safely without special equipment of which do not produce hazardous or difficult to dispose of waste, low toxic emissions in use, above average life expectancy, and simple non-toxic maintenance.

**Resource recovery issues**: which products can be practically removed and reused without major loss of quality, or are easily recyclable.



**Social and ethical issues**: does the manufacturer follow innovative practices and policies, such as fair trade practices and working conditions., and does the company have a reasonable program for research and development.

Pages are carefully designed for easy access and hands-on use, with detailed descriptions and ratings of the products, together with the manufacturers' ordering information. An at-a-glance strip of symbols highlights the merits of each product.

The authors remind us that in addition to the thee R's (reduce, reuse, and recycle) there should actually be a 4-th R added: *rethink*. We should start thinking if it's a wise idea to use products manufactured on the other side of the world when similar materials are available locally. Does it make sense to lug stones half way around the world? Just consider the amount of energy and effort needed to ship the stuff.

Should we be using products that are very energy intensive, especially if they have a limited life span? Does it matter if the raw materials are non renewable? Does it matter if the manufacturing process is a very polluting one (if we don't see the pollution ourselves, we may not be aware if it)? Does it matter if the manufacturers practice ethical labour practices or exploit their workforce?

You may think it's just so much more politically correct, left-wing doublespeak. Everyone is going to have to make their own decision on what is ethical and important to them. However, these are issues that we should be thinking about if we are serious about sustainable development, and serious about making this a better world for future generations. This book simply provides a tool for making decisions. You can ignore the ethical discussions - but it still provides valuable information on sources for new environmentally responsible products.

Materials that are covered in this book are interior finish materials, including: Insulation; Carpeting; Interior Panelling; Floorings; Wall Coverings; Caulking; Adhesives; Mortar; Paints; Stains; Varnishes; Sealers.

One of the interesting things about the product descriptions is that the authors describe briefly how various products are manufactured, so you get a sense of what some raw materials are. It's interesting stuff, but the real value comes in the product descriptions, by company and specific product. It answers the question everyone seems to have today: where do I find a non-polluting, healthy .....?

If you're not concerned about completely up-to-date specific product information, then the paperback book may be enough ($24.95). We know that in today's fast changing world by the time a book is published it is out of date. Because the value of this book is the product assessment, the authors have developed a companion professional edition to go along with the book. The Professional Edition is a loose-leaf binder format, for easy inclusion of updates and bulletins. At $50 ($40 US) with $30 for a yearly subscription ($25 US) this is a bargain.

## Professional edition

The professional edition includes a concise summary of product types, material content, properties, raw material acquisition, production issues, installation and maintenance concerns, and resource recovery. Manufacturer sources include regional distribution contacts (address, phone & fax numbers).

The annual subscription will include semi-annual information updates on changes to standards and new product listings, revisions and additions.

The impressive thing about this project is that it was undertaken by a dedicated group committed to develop the information without major sponsorship by government or industry.

*For copies of the book or for more information, contact:*
*Environmental By Design,*
*Box 34493, Station D, Vancouver,*
*B.C., Canada V6J 4W4*

*David Rousseau author of the pioneer book, Your Home, Your Health & Well-Being is an award-winning design professional and has been an environmental building consultant for over twenty years.*
*Kim LeClair is senior editor for the Interior Design Institute.*

Manufacturers are invited to provide information for possible inclusion in future updates. An information package for suppliers will be sent out on request. It includes a description of the criteria for the 14 graphic symbols, and the minimum threshold for credit.

The information manufacturers must supply includes:

**Production information**: recycled content; sustainably acquired or renewable resource; in-plant energy efficiency and recycling; plant emissions standards.

**Packing/shipping**: minimum, recycled or recyclable packaging; minimum transport energy.

**Installation and use**: installation hazards minimized?; low toxic emissions in use; durability; simple or non-toxic maintenance.

**Resource recovery**: reusable; salvageable; recyclable.

**Social and ethical issues**: fair business practices; research & education programs.

*for more information, contact:*
*Environmental By Design,*
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# Technical Research Committee News

**Canadian** Home Builders' Association

*Work of the TRC continues to give priority to ensure that the builders' needs and point of view are considered and acted upon by those in the research and regulatory communities.*

## Sprinklers

The TRC requested a cost-benefit analysis of sprinklers in multi-family buildings. The work has been finalized and released. This study, funded jointly by CMHC, NRC and the Ontario Ministry of Housing, was done by the IBI Group in Toronto.

To the surprise of many, the consultants do not consider mandatory sprinklers in multiple unit residential buildings to be cost effective. Their reasoning for this conclusion was partly based on the death rate in multi residential buildings being very low (1.5 chances per million in high rise compared to 4.5 chances per million in low rise). This examination looked at the costs and benefits of sprinklers in Part 3 buildings (multi family buildings). This is critical because the NBC Part 3 Standing Committee, on the advice of their Sprinkler Task Group, has published proposed changes which would substantially extend sprinkler requirements in Part 3 buildings.

The model used by the consultants to arrive at the cost benefit figures is the one which was commissioned and paid for by the Ontario government. This model can be considered credible since the Ontario government put ¾ million dollars and three years to develop it, and have been using it to assess various code changes since then.

On the low-rise housing side, (Part 9 buildings) the TRC's sprinkler video and updated sprinkler dit continue to be an unqualified "hit", explaining clearly CHBA's position.

## National Building Code Changes

There are an unprecedented number of changes to the 1995 edition of the code, so the TRC has produced a reference document on the proposed changes to the 1995 NBCC. The purpose of the booklet is to provide a document which will characterize the changes in terms of their impact and will make clear how local associations and builders across the country can make comments on various proposed changes. This document will be distributed widely in early October. It is important to make your views known on proposed code changes--you can only do this by responding directly to the Codes Centre in Ottawa (the TRC document explains how to do this). It is more important than ever for local associations and individual members formally to make their views known.

The National Building Code acts a guideline for the provincial codes but the local codes are adopted under provincial legislation. Some provinces have found it more effective to adopt the National Building Code directly, with few changes.

But the question has been raised about the cost of having a distinct building codes in the province, different in different areas. CHBA has a long standing position to support the National Building Code development process. A new position paper is being prepared on this whole issue, as the scope of the codes is changing.

The concern is the direction that some codes are going. For example, the Building Code Act in Ontario has been changed to allow the code to deal with social issues. This is a fundamental departure from the intent of codes and could call into question the appropriateness of the NBCC for use in Ontario.

*The Technical Research Committee (TRC) is the industry's forum for the exchange of information on research and development in the housing sector. Membership includes builder members and representatives from industry, standards and governments bodies with an interest in housing. Anyone with a problem, technical question of suggestions for areas that need to be investigated is encouraged to contact their local Home Builder's Association technical committee or the TRC directly. To contact the TRC:*
*Canadian Home Builders Association,*
*Suite 200, 150 Kaurier Ave. West, Ottawa, Ont. K1P 5J4*
*Tel: (613) 230-3060*



## Updating the R-2000 Standard

The TRC Management Committee has recommended the new standard to EMR for adoption and implementation (now slated for April, 1994), subject to cleaning up of a few details. The TRC has urged EMR to proceed with related requirements, like a new version of HOT-2000, to ensure smooth implementation. We've summarized the major changes that are being proposed in recent issues.

A document that compares the proposed revisions to the existing requirements, and why some of the changes were introduced, is being circulated for comment among the provincial Technical Committees and program partners. If anyone wants to review and make comments, contact the TRC for a copy of the document.

## Residential Ventilation: Ontario Code Requirements

Effective July 1, 1993 amendments to the Ontario Building Code come into effect. These include a new section on mechanical ventilation for housing (Part 9 buildings).

The 1993 Code spells out four new Options for ventilation systems that do not need Part Six design. None of them can be used in a house that has any spillage-susceptible gas or oil appliances. That means you can't have natural draft gas or oil furnaces or water heaters - or natural or induced draft gas fireplaces. Because of new appliance efficiency regulations few natural draft gas furnaces are available any more in Ontario. However, even induced draft furnaces will be considered natural draft if they share a natural draft flue. Natural draft gas and oil water heaters and oil-fired furnaces are common, as are natural and induced draft gas fireplaces.

Wood Fireplaces are Only Allowed With HRV and CO Detector

Solid-fuel burning appliances are not allowed with a basic exhaust-only system. They can only be used when the ventilation system uses a balanced HRV. Direct vent gas fireplaces are allowed in any of the four systems. The carbon monoxide detector is intended to warn people if a smouldering fire starts to backdraft.

## You asked us:

*Why should I buy argon fill windows? Isn't low-e good enough?*

First we should take a look at how a window works.

Windows are unique because they not only guard against the elements, but also allow light and air into the house, and provide views. However, even the most energy efficient windows have less resistance to heat loss than the wall. The glass itself is not a good insulator.

Low-e or low emissivity glazing improves the thermal performance of the window. Low-e, like regular glass, allows sunlight into the building in the form of short-wave solar radiation. The radiation is absorbed by the interior of the building and radiated as heat (which is long wave radiation). Standard glass absorbs this radiation and prevents it from leaving. But once the glass absorbs the radiation, it gets warmer and starts to re-radiate the heat, a lot of it back outside. Low-e coatings prevent this long wave radiation from passing through the glass by reflecting it like a mirror back into the room.

The radiant component of heat loss is only one of three (the others being conduction and convection). The air space in a sealed double glazed unit contributes an important portion of the insulating properties of the window. The bigger the space, the more likely that a convection current can be set up within the space. The optimum air space is around ½" to ¾" in width.

So why use argon gas? It has been found that an inert gas like argon will improve the performance of a window with low-e glass by around 15%. This is because the molecules of argon are larger and heavier than conventional air (which is mostly a mixture of nitrogen and oxygen), so the air within a sealed unit will not setup a convection current as quickly as with regular air fill. You could think of gas fill as a transparent jelly in comparison to the regular air fill.

The exact improvement will depend on a number of factors, including size and type of window, spacers, frames, and low-e coatings. Low-e coatings themselves vary from manufacturer to manufacturer, and have different properties.

## Quebec Encourages Energy Conservation?

The Quebec government is closing the Montreal office of it Bureau de l'efficacité énergétique (BEE). All BEE operations will be "rationalized" at the BEE Quebec City office, in the Ministry of Energy and Resources.

It appears that the Ministry's policy has been to give the BEE a low profile so people won't call it for advice. Just in case anyone tried, and to make it easier to find the Montreal office, the BEE sign outside its Montreal offices was removed. Yet the official policy of the Quebec Ministry aims for Quebec's economy to use 15% less energy than expected in 2001 and for consumer bills to be 8% lower in 2001.

The BEE group was responsible in the past for a wide range of public outreach programs. From 1978 to 1985 they performed energy audits and subsidized insulation in 340,000 homes, as well as providing reliable technical support for the past 15 years.


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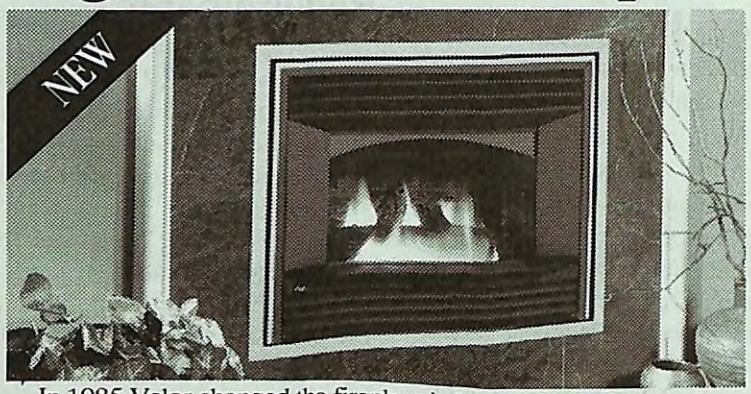


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